

**REMARKS**

The Examiner is thanked for the due consideration given the application. A substitute drawing figure is provided. The specification has been amended to improve the headings.

Claims 12-20 and 22-26 are pending in the application. Claim 12 has been amended to better set forth the invention being claimed. Claim 14 has been amended to generally incorporate subject matter canceled from claim 12. Claims 22-26 are newly presented. Independent claim 22 generally sets forth subject matter found in claims 12 and 13. Support for new claims 23-26 can be found in paragraphs 0019, 0040 and 0041 of the specification.

No new matter is believed to be added to the application by this amendment.

**The Drawings**

The Official Action asserts that Figure 1 should be labeled with a heading. The comments in the Official Action have been considered, and a substitute drawing figure has been provided.

**Rejections Under 35 USC §103(a)**

Claims 12-14 and 16-20 have been rejected under 35 USC §103(a) as being unpatentable over TAMURA et al. (14<sup>th</sup> Annual Meeting of the IEEE, Vol. 1, 12-13 Nov. 2001, pp.97-98) in view of LEDENTSOV et al. (U.S. Publication 2003/0206741). Claim 15 has been rejected under 35 USC §103(a) as being unpatentable over

TAMURA et al. in view of LEDENTSOV et al., and further in view of KAMIOKA et al. (JP 2001-024289). These rejections are respectfully traversed.

The present invention pertains to a modulator-integrated light source that operates over a wide temperature range. The modulator-integrated light source of the present invention is illustrated, by way of example, in Figure 2A of the application, which is reproduced below.

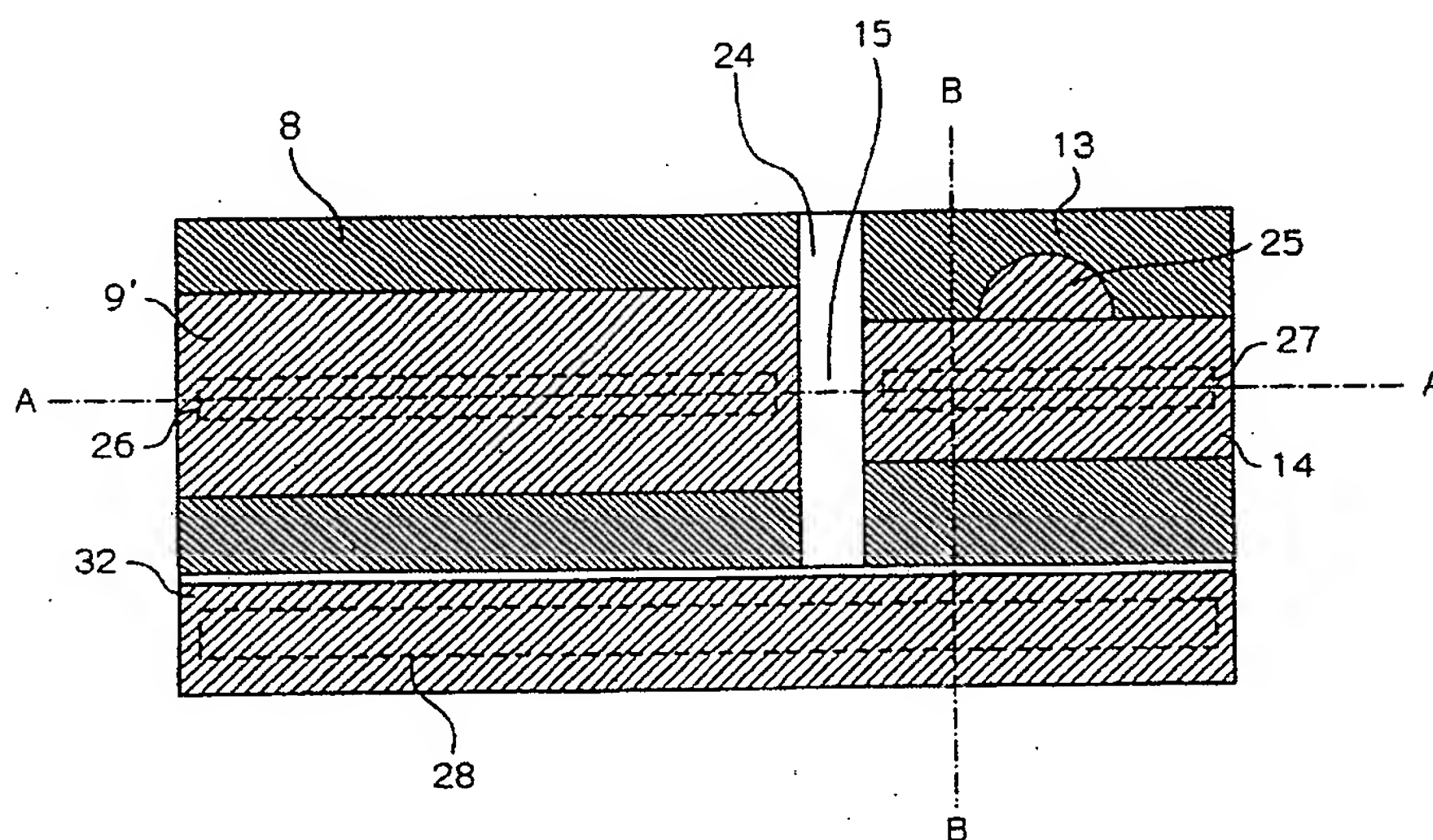


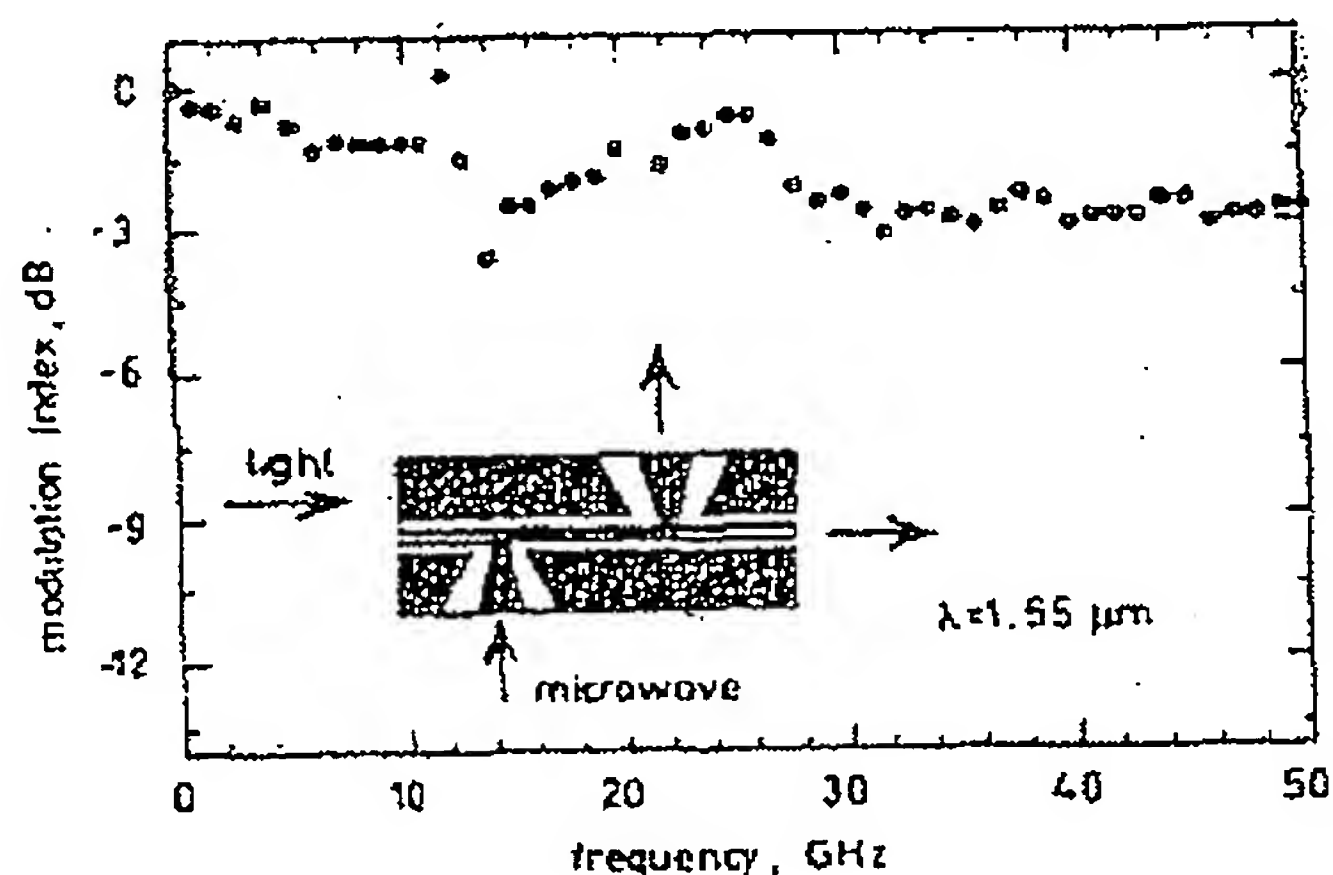
Figure 2A shows a p electrode 14, an n electrode 32 and contact windows 26 and 28. An electrode separator 15 and SiO<sub>2</sub> film 24 divide the p electrode 14.

The electroabsorption of the optical modulator of the present invention satisfies the condition " $L \times B \geq 2000 \mu\text{m} \cdot \text{Gb/s}$ " where L is a length of said electroabsorption optical modulator and B is an operating frequency," as is set forth in claim 12 of the present invention. Claim 12 of the present invention also

optimizes (that is, eliminates) temperature effects by setting the energy conversion value  $\Delta X$  of a detuning amount to be "40 meV  $\leq \Delta X \leq 100$  meV."

TAMURA et al. pertain to ultrafast electroabsorption modulators. The Official Action refers to the first full paragraph at column 2 on page 97 of TAMURA et al., which states:

Fig. 1 shows the measured modulation index against frequency. Although spikes due to the microwave package resonance were observed, (which are not essential for the modulation principle and can be removed), an electrical 3-dB modulation bandwidth of more than 50 GHz is obtained at 1.55  $\mu\text{m}$  wavelength.



**Fig.1 Measured modulation index against frequency**

This disclosure of TAMURA et al. pertains to modulation bandwidth declining as the frequency increases to 50 GHz. However, this disclosure of TAMURA et al. fails to teach a parameter that is the product of the length of the optical modulator  $L$  and the operating frequency  $B$  such that " $L \times B \geq 2000 \mu\text{m} \cdot \text{Gb/s}$ ," as is set forth in claim 12 of the present invention.

The Official Action acknowledges that TAMURA et al.

fail to disclose setting the energy conversion value  $\Delta X$  of a detuning amount to be  $40 \text{ meV} \leq \Delta X \leq 100 \text{ meV}$ . The Official Action turns to paragraph 0140 of LEDENTSOV et al. to supply these teachings.

Paragraph 0140 of LEDENTSOV et al. discusses material absorption in the modulator region is a few tens of  $\text{cm}^{-1}$  for 100 meV energy difference and refers to Table 3, which only contains a detuning of 100 meV. However, LEDENTSOV et al. disclose only a single value and fails to teach or infer a range of detuning amount to be  $40 \text{ meV} \leq \Delta X \leq 100 \text{ meV}$ , such as is set forth in claim 12 of the present invention.

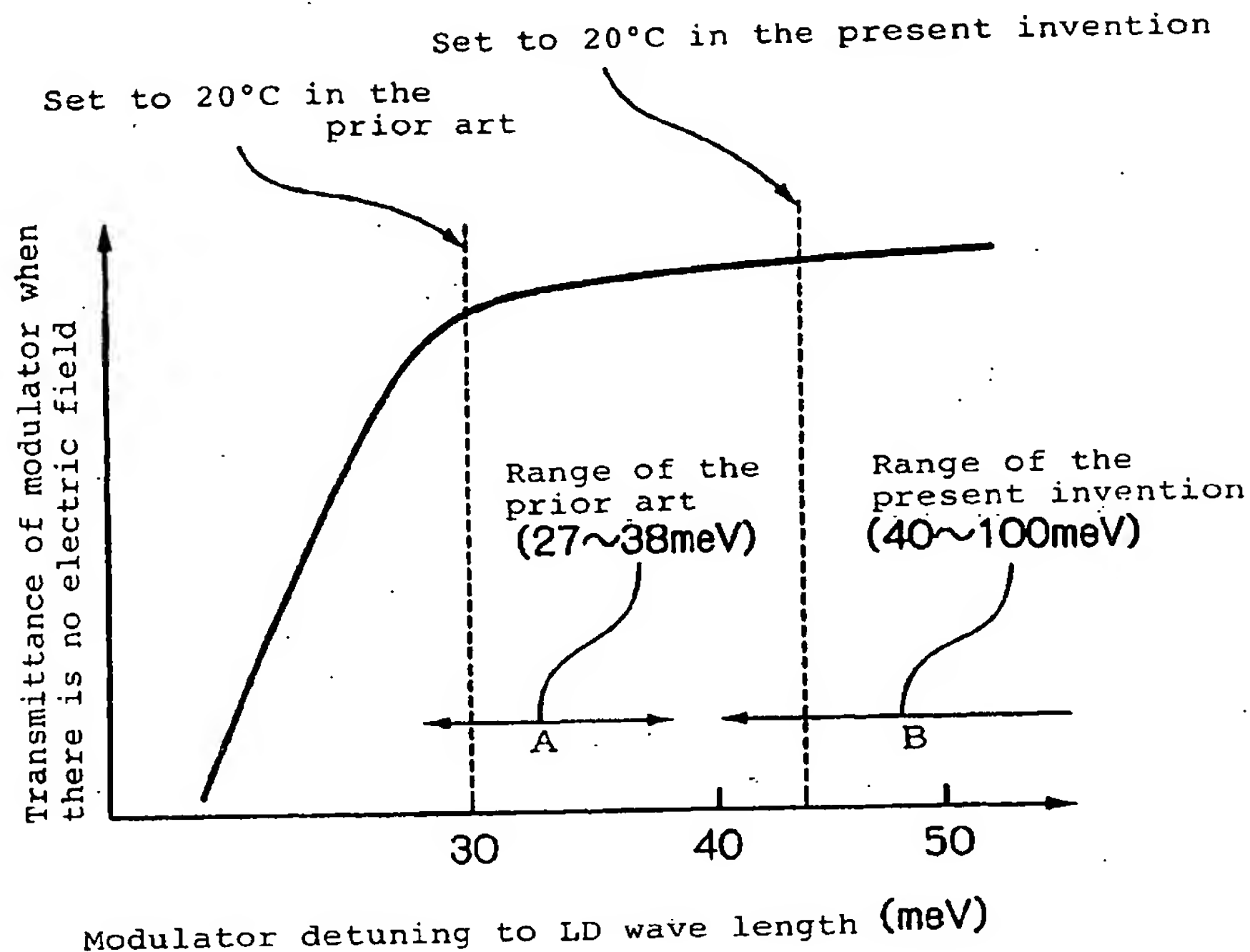
Further, neither TAMURA et al. nor LEDENTSOV et al. teach or infer how this 40-100 meV range achieves freedom from temperature effects. See claims 13, 22 and 23.

The teachings of KAMIOKA et al. fail to address the deficiencies of TAMURA et al. and LEDENTSOV et al.

One of ordinary skill in the art would thus fail to produce independent claim 12 of the present invention from a knowledge of TAMURA et al. and LEDENTSOV et al. (and KAMIOKA et al.) A *prima facie* case of unpatentability has thus not been made. Claims depending upon claim 12 are patentable for at least the above reasons.

Further, the present invention shows unexpected results that would fully rebut any unpatentability that could be alleged. These unexpected results include modulator detuning to greater

wavelength (meV) when set at 20°C, as is shown in Figure 4 of the application, which is reproduced below.



The advantages of the present invention over the applied art are thus clear.

These rejections are believed to be overcome, and withdrawal thereof is respectfully requested.

#### New Claims 22-26

New claims 22-26 have been presented for consideration on the merits.

The advantages of new independent claim 22 include a construction that does not require an amplifier (driver), i.e., a construction that allows low-voltage operation in which the voltage is 1 V or less.

These advantages are discussed in paragraph 0024 of the

specification, which notes that since the modulation bandwidth is necessarily reduced when the modulator length  $L$  is increased, the configuration of the present invention as described above would not be conceivable under ordinary circumstances. For example, the problem in the configurations in Documents 1 and 2 was the improvement of the modulation bandwidth, and increase of the modulator length was therefore not suggested. The present invention therefore is of a configuration that could not have been easily conceived based on the related art.

Paragraph 0038 of the specification additionally notes that in the modulator-integrated light source of the present invention, P-electrode 14 and N-electrode 32 are located on the same element surface, and moreover, high-resistance semiconductor substrate 1 is used as a substrate. By this configuration, the electrostatic capacitance of the modulator is only the electrostatic capacitance of active layer 11, and the modulation speed (Gb/s) and modulator length  $L$  ( $\mu\text{m}$ ) are in an inverse proportional relation. Although the modulator length is normally shortened to raise the modulation speed in a structure of this type, the present invention adopts a construction based on a technical idea that is opposite the ordinary concept, whereby lengthening the modulator length  $L$  such that more of the light that is transmitted through the modulator can be absorbed enables the realization of a construction that does not require an amplifier (driver), i.e., a construction that allows low-voltage